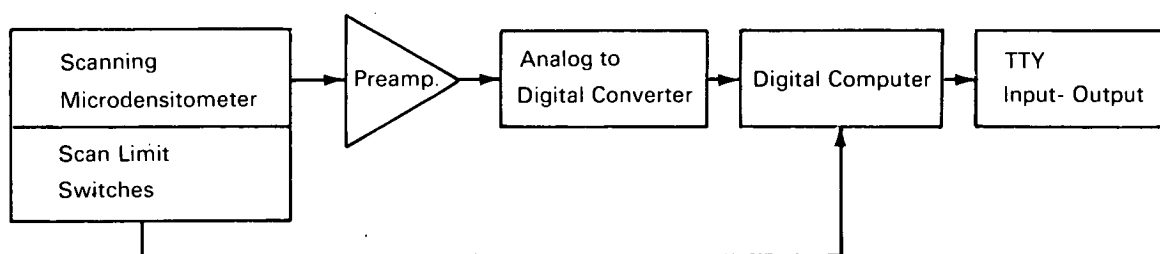


# NASA TECH BRIEF



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## Instrumentation for Bone Density Measurement



Bone density measurement systems with quite acceptable accuracy have been in use for some time. However, as increased interest in this area demands more and more data, the analog instrumentation used for data reduction lacks sufficient speed.

The basic measurement system evaluates the integrated bone density over a specific cross section of bone. A roentgenogram of a standard aluminum calibration wedge and the bone specimen is obtained in a single exposure. Optical transmittance of the developed film is then measured by means of a scanning microdensitometer. The image of the wedge is first scanned to determine optical transmittance versus wedge thickness as recorded on the film. Graphical representation of the optical scanner output for a scan of the wedge image is in the form of an output voltage curve. The bone image is scanned next along the desired cross section, resulting in a second output voltage curve. These curves are the basic inputs for measurement of bone density.

The computation system must now convert the voltage output for the bone scan to a curve of equivalent density (in terms of wedge thickness) and integrate the area under the resulting curve. Conversion between output for the bone scan and equivalent wedge thickness is made using the wedge scan curve. The curve is entered at the value of optical scanner

output and wedge thickness is read on the abscissa. This equivalent wedge thickness is used in the subsequent integration of the density.

In one analog system, in use for many years, conversion between optical scanner output during bone scan and equivalent wedge thickness, is made by using a nonlinear resistance slidewire output from a chart recorder. Integration is accomplished with an electro-mechanical integrator.

A system using a digital computer has been implemented to perform the computation functions similar to those performed by the analog system. Optical scanner output voltage is converted to a digital format for storage and subsequent processing by a digital computer. After both wedge and bone scans have been completed, the computer converts stored bone scan data to equivalent wedge thickness by using the stored wedge scan data. Bone density is then integrated along the scan by using the trapezoidal approximation integration formula. A block diagram of the digital instrumentation is shown in the figure.

In operation, data collection by the computer is controlled by the limit switches of the densitometer, which mark the beginning and end of the scans. Sampling times are controlled by a clock in the computer. The teletype unit is used to control the computer by directing it to prepare for a wedge or bone

(continued overleaf)

scan, specifying bone scan speed used, specifying printout options desired, and is also used in typing identifying information on the printout.

**Note:**

Inquiries concerning this innovation may be directed to:

Technology Utilization Officer  
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Houston, Texas 77058  
Reference: B68-10140

**Patent status:-**

No patent action is contemplated by NASA.

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